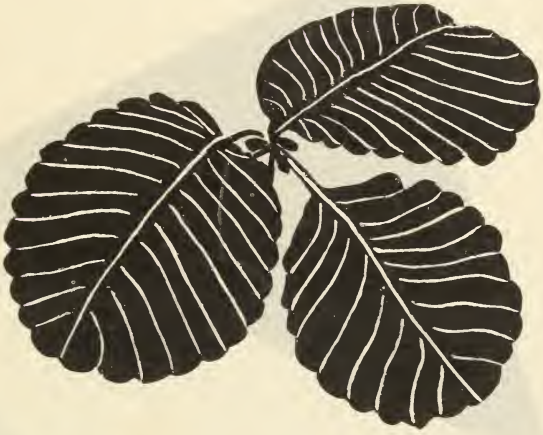
Reducing Virus and Nematode Damage to Strawberry Plants



Leaflet No. 414

U. S. DEPARTMENT OF AGRICULTURE

Reducing Virus and Nematode Damage to Strawberry Plants

Strawberry plants that are substantially free from disease-causing viruses are now available from nurseries the country over.[1] In addition, the plants from many nurseries have undergone treatments that rid them of nematodes.

Growers who plant virus-free, nematode-free stock and keep it clean protect themselves from two common causes of serious strawberry losses. Virus diseases weaken plants, cut runner formation, and hold down berry yields. Nematodes, which are tiny eellike worms, feed on strawberry plant roots and seriously reduce their vigor.

The research that led to today's virus-free and nematode-free strawberry plants was conducted by plant scientists of the Agricultural Research Service of the U. S. Department of Agriculture.

VIRUS-FREE STRAWBERRIES

In virus-free plants strawberry growers have a solution to a problem that has plagued them for years.

The virus-disease problem

Virus diseases of any plant are hard to combat; ordinarily, nothing can be done to restore an infected plant to health. Control measures can be directed only toward prevention of infection of healthy plants and toward development of tolerant varieties.

At first, solving the virus-disease problem in strawberries by either method of control looked hopeless.

DIFFICULTIES IN CONTROL BY PREVENTION

Control by prevention seemed impossible for two reasons.

1. By the time it was recognized that degeneration of strawberry planting stocks was resulting from virus infections and that stringent virus-control measures were needed, nearly every plant in the country was already infected.

Several damaging viruses were recognized and were found to be widespread in every section of the country where strawberries were grown; often two or more viruses were found in the same plant. The extent of virus infection was increasing each year. Infected mother plants passed the infection, through runners, to all daughter plants. Viruses were also spread from plant to plant and from field to field by aphids.

2. Growers had no way of identifying the few virus-free plants that existed.

For some time after infection, infected and uninfected plants look equally healthy. Even in plants that have had virus diseases for months, symptoms often are not clear and definite. Symptoms vary with the variety of strawberry, the particular virus or viruses present, the stage of plant growth, and weather conditions. Infected

[1] For simplicity of expression, plants that are substantially free from recognized viruses are referred to throughout this leaflet as "virus free." At present there is no way to determine that a plant is free from all viruses.

plants of some varieties show no obvious symptoms, though some of them may have greatly reduced fruit yields.

DIFFICULTIES IN CONTROL BY TOLERANT VARIETIES

Controlling virus diseases in strawberries by originating new tolerant varieties is impracticable. All adapted varieties are susceptible. To duplicate these with tolerant varieties would entail development of new varieties for all areas of production and for early, midseason, and late markets; it would also entail development of new varieties for special conditions of soil and climate and for special food uses.

Development of virus-free plants

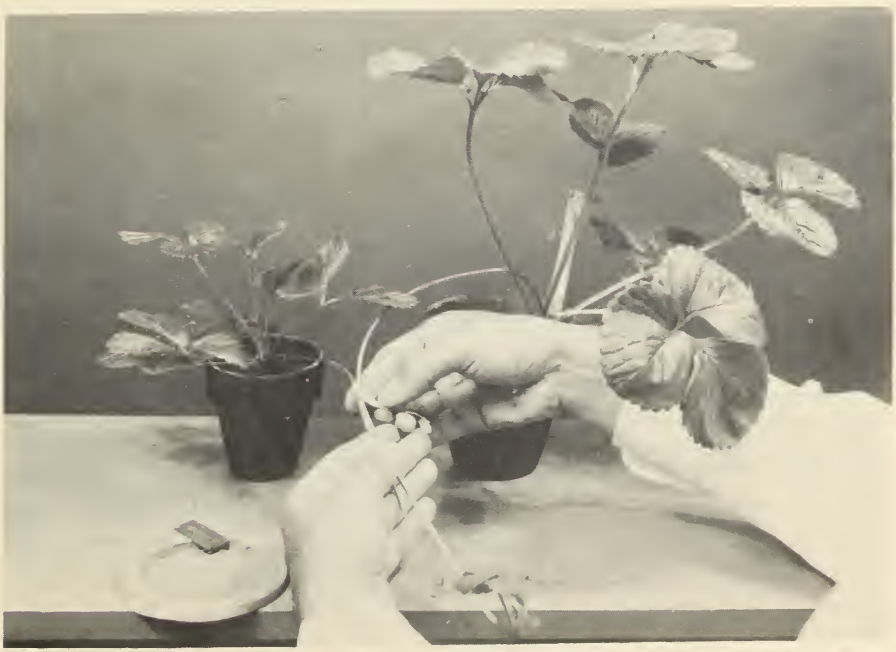
By 1946 plant scientists in the Department of Agriculture had decided that the virus-disease problem might be solved by the development of virus-free planting stocks. If growers could be supplied with virus-free plants, they could then control virus diseases by preventing infection of these plants.

The researchers set about to develop virus-free plants in two steps. The steps: (1) To find at least one virus-free plant of each variety: (2) to multiply these plants into enough to supply growers.

FINDING VIRUS-FREE PLANTS

First, the researchers devised a way to test strawberry plants for the presence of virus. Then, using this test, they searched the country for plants uninfected by viruses.

The Test.—A strawberry plant is tested by a procedure called "indexing." A runner of a plant being tested is grafted to a runner of an index (or indicator) plant. The



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Testing a strawberry plant for presence of virus. Runner of plant being tested, at right, is grafted to runner of virus-free index plant at left. If plant at right is virus infected, index plant will soon show clear-cut symptoms.

indicator is a plant of a variety of wild strawberry that is extremely sensitive to viruses. If the plant being tested has a virus infection, the index plant shows clear-cut symptoms a few weeks after the grafting.

The Search.—The USDA researchers asked research workers in the States and nurserymen and growers the country over to send in for testing vigorous plants that appeared to be virus free.

Most of the plants sent in were virus infected. But a few were the scarce, virus-free plants for which the researchers were looking.

In 1946, virus-free plants were found for 3 varieties. By 1955, virus-free plants had been found for 42 varieties; these 42 varieties represent 95 percent of the commercial production in this country. Today, the search continues for virus-free plants of a few remaining varieties.

MULTIPLYING VIRUS-FREE PLANTS

As soon as a virus-free plant is found for a variety, the USDA plant scientists begin to multiply it. Several commercial nurseries help.

The various steps in the multiplication process are described in the timetable below for Florida Ninety.

February 1954.—3 virus-free plants found. Runners from these plants potted in sterilized soil. Pots placed in greenhouse.

Spring 1954.—Enough runners obtained from potted plants to set out 100 feet of row. Runners planted in open in doubly fumigated soil in a location over 3,000 feet away from nearest strawberries that might have been virus infected. Plants were dusted with 1-percent parathion to protect them from aphids.

January 1955.—6,500 plants harvested. Placed in cold storage.

March–April 1955.—Plants sent to cooperating nurserymen. Nurserymen planted them under conditions that kept them virus free.

November 1955.—Plants available to other nurseries.

January 1956.—Limited quantities of plants available to growers.

Because Florida Ninety is a very prolific runner-making variety, only 2 years elapsed between the time the first virus-free plants were found and the time growers could buy some virus-free plants at nurseries. For less prolific varieties, the multiplication process may take as long as 5 years.

N–18633

A screenhouse protects strawberry foundation stock from aphids that spread viruses.

Availability of virus-free plants

By 1956 virus-free plants of the following 30 varieties were generally available to growers:

Albritton	Marshall
Armore	Massey
Aroma	Midland
Bellmar	Missionary
Blakemore	New York
Catskill	Pocahontas
Dixieland	Redstar
Dunlap	Robinson
Fairfax	Siletz
Florida Ninety	Stelemaster
Howard 17 (Premier)	Sparkle (Paymaster)
Klondike	Tennessean
Klonmore	Tennessee Beauty
Konvoy	Tennessee Shipper
Marion Bell	Vermillion

Also available to growers in 1957 are limited quantities of virus-free plants of seven other varieties—Earlidawn, Eden, Empire, Gem (Superfection, Brilliant), Redglow, Shasta, and Surecrop.

By 1960 growers should be able to buy virus-free plants of the following varieties: Donner, Lassen, Orland, Streamliner, and Tahoe. A virus-free plant has been found for each of these varieties; the multiplication process is just beginning.

Keeping plants virus free

In order to stay virus free, a strawberry plant must be protected from virus infection throughout its lifetime.

Specific protective measures recommended for nurserymen and for growers are given below.

NURSERYMEN

As far as possible, grow only virus-free, aphid-free stock.

If possible, grow foundation stock in a screenhouse. Screenhouses are designed primarily to keep out aphids that spread viruses. They also serve as shade and windbreak, thus making maximum plant production possible.

N—18634

Applying a 1-percent parathion dust to foundation stock grown in the open field. Dust protects plants from virus-spreading aphids. Operator wears a respirator as a protection from this extremely dangerous poison.

Screenhouses now in use range in size from those covering a few square feet to those covering half an acre. A screenhouse 20 feet by 20 provides enough space for the production of about 8,000 plants—enough to set about 2 acres in the open field if plants are spaced 3 feet apart.

Plants that are grown in open fields should be located at least 3,000 feet from other strawberries, cultivated or wild. Regulations in some States require that open fields in which foundation stock is grown be at least 1 mile from other strawberries.

Dust plants in screenhouse or open field every 2 weeks from time of planting until late fall with 1-percent parathion dust. Use 20 to 30 pounds of dust per acre. In areas with mild winters foundation stock should be dusted the year around.

GROWERS

Plant only virus-free, aphid-free stock. Locate new plantings as far away from older plantings as feasible.

If aphid-free stocks are set it will probably not pay most growers to dust. However, where aphids are abundant (as along the Pacific Coast) some control measures are desirable. Under such conditions, dust both old and new plantings at least twice in early spring and 2 or 3 times in the fall.

For dusting, use 1-percent parathion, 4-percent malathion, or 1-percent TEPP. Time the applications according to the following schedule:

First—As early in the spring as possible on a day when the temperature reaches 70° F.
Second—No later than the time when the first blossoms appear.
Third—About September 1.
Fourth—2 weeks after the third application.
Fifth—2 weeks after fourth application.

PRECAUTIONS

Parathion, malathion, and TEPP are poisons. Handle them in accordance with the manufacturer's directions on the package. Parathion and TEPP are extremely dangerous poisons. These insecticides should be used only by a trained operator who will assume full responsibility and enforce the precautions prescribed by the manufacturer. *Do not apply parathion to fruiting fields between fruit-set and end of harvest.* Malathion may be applied up to 3 days before harvest. TEPP may be applied up to 24 hours before harvest.

NEMATODE-FREE STRAWBERRIES

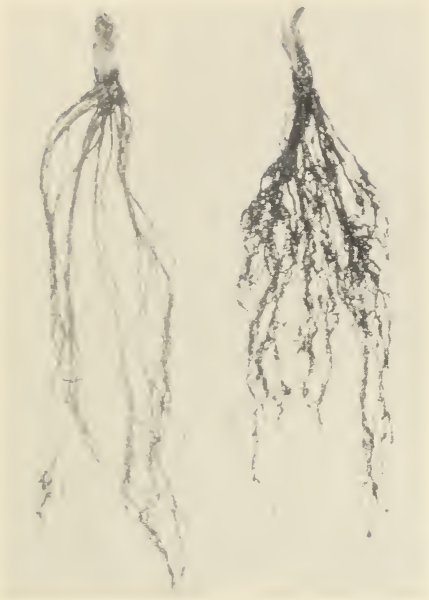
In 1954, plant research at the U. S. Department of Agriculture obtained the solution to a second major problem of strawberry growers—nematode infestation of planting stocks.

The problem

Science had found a way to kill most of the nematodes in the soil—by chemical fumigation. But it had no way to kill nematodes on strawberry plants, without also killing the plants.

The search for virus-free plants revealed that much of the planting stock of the country was nematode infested. Every original virus-free plant found was infested with one or more kinds of nematodes.

Consequently, when the virus-free plants were set in clean or fumigated soil to multiply, they in-



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Roots of strawberry plant at left are free from nematodes; roots at right are infected with the northern root-knot nematode and one species of meadow nematode.

troduced or reintroduced nematodes into the soil. The nematodes increased and most of the runner plants became infested. These, in turn, infested their daughter plants.

Result: The researchers were building up stocks of virus-free but nematode-infested strawberries.

The solution

In the fall of 1953, USDA scientists began experimenting with hot-water treatments to free plants of nematodes. By the summer of 1954 they had perfected the following two treatments, which they made available to nurserymen.

Treatment 1.—Dormant plants are immersed for 2 minutes in water at 127° F. Recommended for plants that are infested with only two species of root nematodes—root-knot and meadow (or root-lesion) nematodes.

Treatment 2.—Dormant plants are immersed for 7 minutes in water at 121° F. Recommended for plants infested with insects or mites as well as with root nematodes and for plants infested with foliar nematodes.

Before treatment, plants must be held in cold storage at 30° F. for at least 2 weeks for them to become fully dormant; otherwise they may be killed. After treatment they may be planted at once or returned to cold storage at 30° for as long as a month before planting.

In 1954 and 1955, over 2 million strawberry plants were given one of these treatments. The nurserymen who used the treatments were so favorably impressed with the results that they treated all their stock in 1956.

Keeping plants nematode free

Most cropland in the United States is infested with nematodes that attack strawberries. Therefore, in order to keep plants free from nematodes, it is usually necessary to fumigate the soil in which they are to be planted.

For effective control in *nursery plantings*, double fumigation is recommended. Fumigants now on the market that are suitable for this use contain either dichloropropene or ethylene dibromide as the active ingredient.

Fumigants containing 50 percent dichloropropene are used at the rate

PRECAUTIONS

Anyone handling a soil fumigant should observe these precautions: Avoid prolonged breathing of the fumes. *Never* risk getting the liquid into the eyes or mouth. Do not allow the liquid to stay on the skin; wash it off promptly with soap and water. If liquid is spilled on shoes, gloves, or other clothing, remove the garment without delay.

Hot-water treatment to free strawberry plants of nematodes. Basket of plants to be treated is being placed in treating unit. Baskets of treated plants are in cooling tank.

of 30 gallons per acre at each application. Fumigants containing 83 percent ethylene dibromide are used at the rate of 7½ gallons per acre for each application. There must be an interval of from 1 to 2 weeks between applications.

Cost of such double applications is about $100 per acre.

If strawberries are to be *grown for fruit production* on land in which nematodes are known to be a problem, a single application of one of the fumigants mentioned above is suggested. Apply fumigant at the same rates as for nursery plantings. The fumigation should be done the first year on only part of the land to see if increased yields justify the expense.

In Southern States, fumigation can be done either in the fall or the spring; in the Northern States it must be done in the fall to avoid delays in planting. Plants should not be set in fumigated soil until at least 2 weeks after the last fumigation. The fumigant should be applied to the soil only when the soil temperature measured at a depth of 6 inches is above 50° F.

When using soil fumigants, the manufacturer's directions and precautions must be followed exactly.

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